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Potassium Problems in the Dialysis Patient

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What is potassium?

Like sodium and calcium, potassium is a mineral. In 1807, Sir Davy first discovered potassium in potash (a type of ash).

- “K⁺” is the symbol for potassium (from *kalum*, the Latin word for potash). The “+” sign indicates it is an electrolyte that carries a positive charge.
- Most of the body’s potassium is located inside the cells with only a small amount in the blood. For patients, the preferred range for the serum (blood) potassium is 3.5 to 5.5. meq/l.

Test Your Knowledge

- 1) What was your last serum (blood) potassium reading? ____
- 2) Was this reading in the acceptable range? _____

Answer: If you are unsure, check with your nurse, dietitian, PCT or physician.

Potassium & your heart

Potassium plays a key role in smooth muscle contraction, especially within the heart. If the serum potassium is either higher or lower than normal, heart problems can result.

- *Too much potassium* in the blood causes the contractions within the heart to slow (causes the pulse rate to be low). If the potassium level continues to increase, the pulse may slow to the point where the heart literally stops, and a cardiac arrest (sudden death) would occur.
- *Too little potassium* in one’s blood creates the opposite problem – the heart becomes too excitable. This irritability often causes an irregular pulse with extra beats, called PVCs (premature ventricular contractions) and can progress to V tach (ventricular tachycardia) or V fib (ventricular fibrillation). Again, sudden death could result.

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With hemodialysis, what causes the potassium levels to change?

Between hemodialysis treatments the diseased kidney is not normally able to rid the blood of potassium that is eaten in foods, and the serum (blood) potassium increases.

Between Hemodialysis Treatments
 Food intake + ↓ in kidney function → ↑ in serum potassium

Definition

Diffusion

- The movement of particles from a higher concentration to a lower concentration.
- During dialysis, diffusion occurs across the dialyzer membrane (between the blood and the dialysate).

During hemodialysis, diffusion occurs inside the dialyzer, causing potassium ions to leave the blood and enter the dialysate or “bath” (see “definition” box). As long as the dialysate’s concentration of potassium is *lower* than the blood level, serum potassium will continue to drop (the potassium ions in the blood will continue to cross over the dialyzer membrane and then simply go down the drain). This slow removal of potassium usually occurs throughout the entire dialysis treatment.

Example: If a patient’s predialysis potassium is 5.5 and this patient’s dialysate concentrate is a 2.0 K+ bath, diffusion will cause the tiny potassium molecules to move from the higher potassium concentration of the blood (5.5) to the lower concentration in the dialysate (2K+). In this scenario, by the end of a dialysis treatment this patient’s potassium blood level will drop to around 3.5 (to the lower range of normal).

During the Hemodialysis Treatments
 An elevated serum potassium + A lower dialysate potassium → ↓ in serum potassium

With peritoneal dialysis (PD), what causes the potassium levels to change?

Potassium concerns are different with peritoneal dialysis than with hemodialysis. With peritoneal dialysis, potassium is removed from the blood with each dialysis exchange. Since peritoneal dialysis occurs at various

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times every day, the blood potassium seldom becomes elevated. It can, however, become low.

According to the “Handbook of Dialysis”, a low potassium is seen in about 10-30% of CAPD patients and is often due to poor dietary intake (eating few potassium foods). Depending on the cause of the low potassium, the dialysis team may recommend either eating more potassium foods or taking a potassium supplement to *increase* the potassium to a normal level.

What else can affect the serum potassium level?

Digitoxin

A heart medication that...

- Strengthens the contraction of each heart beat.
- Slows the heart beat (lowers the pulse rate).

For the person on with kidney failure, potassium foods are main cause of potassium problems. But, depending on the particular patient, there may be other causes. Three are listed here.

- For dialysis patients with diabetes, an *extremely high blood sugar* may cause an increase in serum potassium. When a blood glucose level is quite high (e.g. 1000mg/dl), a ketoacidosis may occur. This acidosis (a high level of acid in the blood) can cause a shift in electrolytes -- hydrogen ions leave the blood and enter the cells while potassium ions exit the cells (enter the blood). A high blood sugar, therefore, can lead to a high serum potassium. As insulin is given and the blood sugar returns to normal, the extra potassium returns to its home” inside the cells.

↑ blood sugar → ketoacidosis → potassium leaves cells → ↑ serum potassium

- The *heart medication called digoxin (digitoxin; dig)* can also play a role with potassium. If a patient is taking digoxin AND his serum potassium is low, heart problems such as an irregular pulse (PVCs) and V tach are more likely to result. Because of this, physicians may prescribe a 2K+ or higher dialysate for hemodialysis persons who are taking digoxin.

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- With a few types of kidney failure, the diseased kidney actually rids the person's blood of too much potassium. In this instance, to prevent the serum potassium from becoming too low...
 - Hemodialysis patients may be prescribed a higher potassium dialysate, possibly a 3K+ or 4K+ bath. With these higher baths, diffusion will cause the potassium to move *from* the dialysate *to* the patient (from the higher concentration of the dialysate to the lower concentration of the blood), and the patient then leaves the unit with a higher, more normal potassium.
 - A potassium supplement may be given to PD patients.

The goal: An acceptable potassium level

Your **dialysis team** helps achieve this goal by...

- *Monitoring* your monthly blood potassium level.
- *Providing education*. One key role of our dietitians is to give you information on foods that are both high and low in potassium.
- For hemodialysis patients, *verifying the dialysate (bath) concentration* attached to your machine is correct (same as ordered by the physician).

You can help by:

- Keeping your *intake of high potassium foods* at a safe level.
- For hemodialysis patients, knowing what *potassium dialysate concentration (bath)* is ordered for you (e.g. a 1K+, 2K+, 3K+..). Then, prior to each treatment, checking to see that the bath hooked up to your machine is correct. This can be done either by asking your PCT what potassium "bath" is being used or by asking him to show you how to check this on your own.
- *Reporting any unusual symptoms*. As mentioned earlier, with a *too low* of potassium, you may notice extra heart beats or palpitations. With a *too high* of potassium, you may feel more tired and weak ("my legs feel like rubber"), plus your pulse rate may be slow. While there are many possible reasons for these symptoms, always report them to your dialysis team.

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Is there a moral to this story?

Yes, a serum potassium level, when out of range, can be dangerous.

Please...

- 1) Know your potassium level.
- 2) Monitor your potassium food intake – strive to keep it acceptable.
- 3) If on hemodialysis, verify the correct potassium (K⁺) dialysate is hooked to your machine.
- 4) Report any unusual symptoms.

Thanks for your interest in learning!